Connecting Cisco ATM Network Modules to the Network

Revised: May 1, 2008, OL-12815-01

This guide describes how to connect Cisco Asynchronous Transfer Mode (ATM) network modules to your network. It contains the following sections:

- ATM-25 Network Module, page 1
- ATM T3 and E3 Network Modules, page 3
- ATM OC-3 Network Modules, page 5
- Related Documents, page 17
- Obtaining Documentation, Obtaining Support, and Security Guidelines, page 17

ATM-25 Network Module

The ATM-25 network module (see Figure 1) provides ATM traffic shaping for use with asymmetric digital subscriber line (ADSL) uplink speeds, and protocol support for permanent virtual circuit (PVC) environments. The network module provides full support for multiprotocol encapsulation over ATM Adaptive Layer 5 (RFC 1483), classic IP over ATM encapsulation (RFC 1577), and Point-to-Point Protocol (PPP) over ATM.

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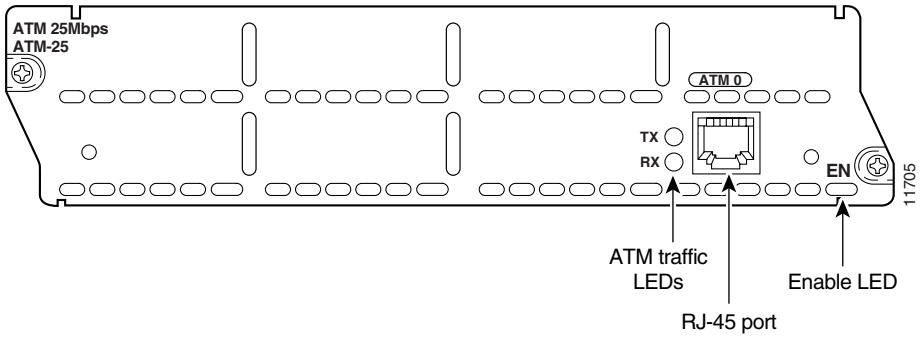
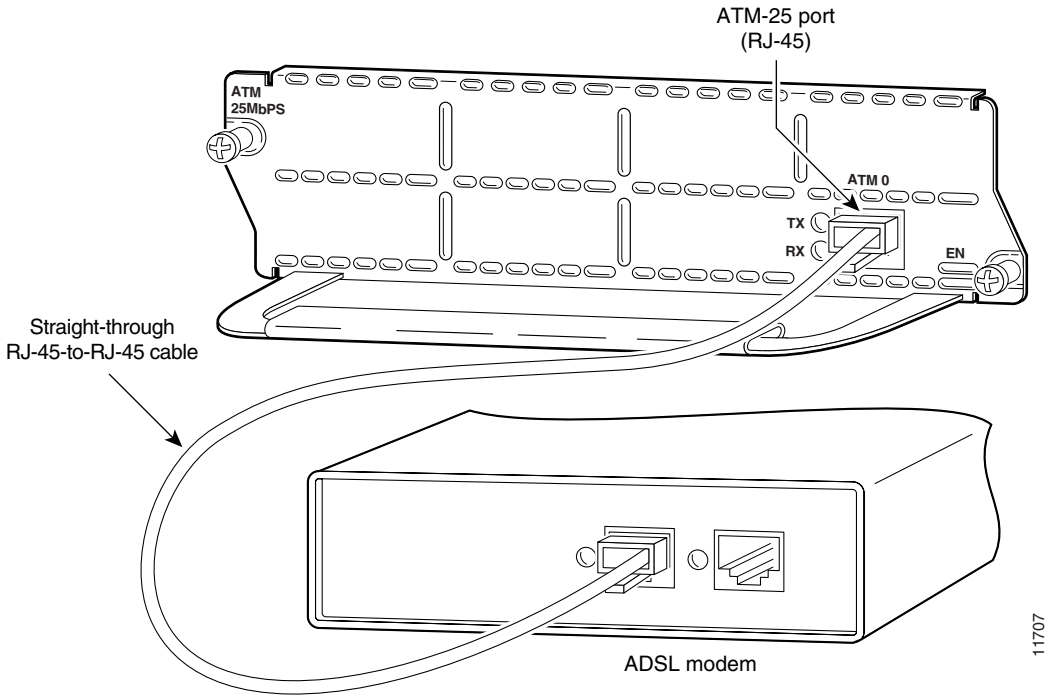
Figure 1 ATM-25 Network Module



Connecting ATM-25 Ports to the Network

The ATM-25 port is a standard RJ-45 jack, color-coded light green. Use a straight-through modular RJ-45 UTP Category 3, 4, or 5 cable or STP Category 1, 1A, 9, or 9A cable to connect the port to an external ADSL modem. See Figure 2.

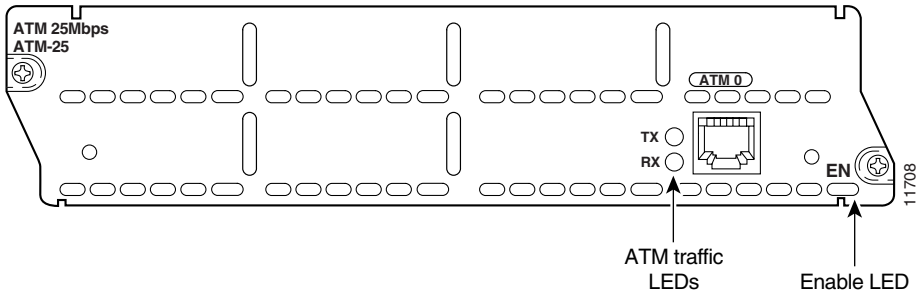
Figure 2 Connecting the ATM-25 Module to an ADSL Modem



ATM-25 Network Module LEDs

Figure 3 shows ATM-25 network module LEDs.

Figure 3 ATM-25 Network Module LEDs



All network modules have an enable (EN) LED. The enable LED indicates that the module has passed its self-tests and is available to the router. The ATM-25 network module has the additional LEDs shown in Table 1.

Table 1 ATM-25 Network Module LEDs

LED	Meaning
RX	Module is receiving ATM traffic
TX	Module is transmitting ATM traffic

ATM T3 and E3 Network Modules

ATM T3 and E3 network modules provide T3 and E3 ATM connectivity for high-bandwidth data applications. There are three versions of these network modules: the ATM T3 Network Module, the ATM E3 Network Module, and the ATM T3/E3 Network Module. See Figure 4, Figure 5 and Figure 6. These network modules offer full support for multiprotocol encapsulation over ATM Adaptive Layer 5 (RFC 1483), classic IP over ATM encapsulation (RFC 1577), Point-to-Point Protocol (PPP) over ATM, and LAN Emulation (LANE). Up to 1024 virtual circuits (VCs) are supported on the ATM T3/E3 network modules.

Figure 4 ATM Network Module with T3 Interface

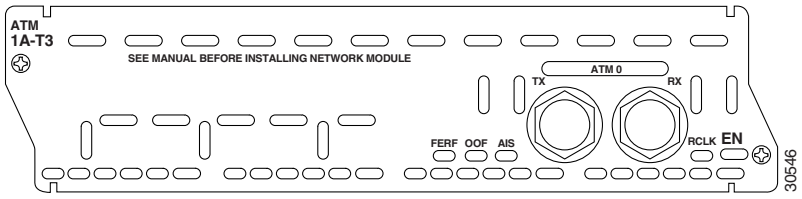


Figure 5 ATM Network Module with E3 Interface

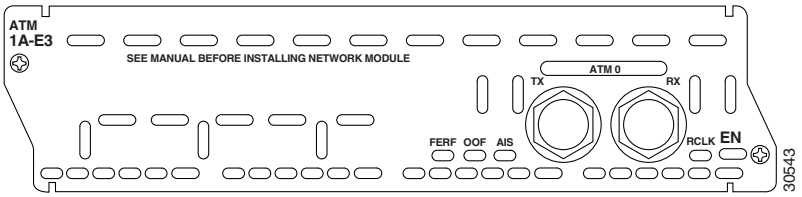
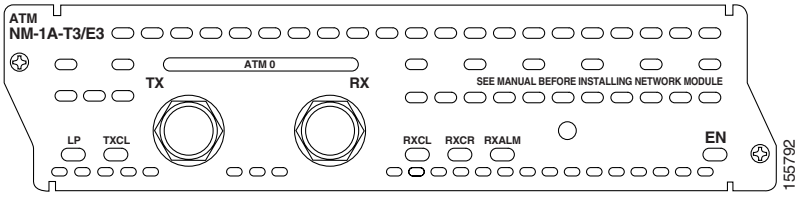


Figure 6 ATM Network Module with one T3/E3 Interface



Note The ATM T3 network module has a sensitive receiver. If you use a short T3 cable, it is possible to saturate the receiver, leading to bit errors. If this occurs, we recommend one of the following:

- Reduce the transmit level of the device attached to the T3 network module. Many devices have a line build-out (LBO) configuration setting for this purpose.
- Insert a 4-dB attenuator on the receive side of the T3 network module.

Connecting ATM T3 and E3 Ports to the Network

Use a coaxial cable to connect the module BNC port to a T3 or E3 network.

ATM T3 Network Module and ATM E3 Network Module LEDs

The ATM T3 network module and the ATM E3 network module have the LEDs shown in Table 2.

Table 2 ATM T3 Network Module and ATM E3 Network module LEDs

LED	Color	Meaning
EN	Green	Module has passed its self-tests and is available to the router.
RCLK	Green	Receive clock has been detected.
FERF	Yellow	Far-end receive failure.
OOF	Yellow	Out of frame.
AIS	Yellow	Alarm indication signal.

ATM T3/E3 Network Module LEDs

Table 3 shows the LEDs for the combined ATM T3/E3 network module.

Table 3 ATM T3/E3 Network Module LEDs

LED	Color	Meaning
TXCL	Green	Cell transmitted.
RXCL	Green	Cell received.
RXALM	Yellow	Alarm indication signal.
RXCR	Green	Carrier present.
Loopback LED	Green	Loopback

ATM OC-3 Network Modules

ATM OC-3 network modules provide full 155-Mbps ATM connectivity, including STS-3c and STM-1 framing, for high-bandwidth data applications and voice-data integration applications. Characteristics and installation of these modules are described in the following sections.

- OC-3 Network Modules for Cisco 3600 and Cisco 3700 Series Routers, page 5
- ATM-OC3-POM Network Module for Cisco 3800 Series Routers, page 10
- Laser Safety Guidelines, page 13
- Fiber-Optic Transmission Specifications, page 14

OC-3 Network Modules for Cisco 3600 and Cisco 3700 Series Routers

This section describes the following OC-3 (Optical Carrier level 3) network modules for most Cisco 3600 and Cisco 3700 series routers.

Note ATM OC-3 network modules are not supported by the Cisco 3631 router.

The following modules are supported on the Cisco 3600 series routers and the Cisco 3725 router:

- NM-1A-OC3MM provides a multimode (MM) fiber uplink port. See Figure 7.
- NM-1A-OC3SMI provides a single-mode intermediate-reach (SMI) fiber uplink port. See Figure 8.
- NM-1A-OC3SML provides a single-mode long-reach (SML) fiber uplink port. See Figure 9.

The following modules are supported on the Cisco 3745 router:

- NM-1A-OC3MM-EP provides an MM fiber uplink port with enhanced performance. See Figure 7 for a similar faceplate.
- NM-1A-OC3SMI-EP provides an SMI fiber uplink port with enhanced performance. See Figure 8 for a similar faceplate.
- NM-1A-OC3SML-EP provides an SML fiber uplink port with enhanced performance. See Figure 9 for a similar faceplate.

The following modules are supported on the Cisco 3600 series routers:

- NM-1A-OC3MM-1V provides an MM fiber uplink port and circuit emulation service. See Figure 10.
- NM-1A-OC3SMI-1V provides an SMI fiber uplink port and circuit emulation service. See Figure 11.
- NM-1A-OC3SML-1V provides an SML fiber uplink port and circuit emulation service. See Figure 12.

Circuit emulation service allows the network module to carry voice traffic, such as telephone calls and faxes, over an ATM network simultaneously with data traffic.

If you are using the ATM OC-3/STM-1 circuit emulation service network module, you need both the network module and a 1- or 2-port T1 or E1 multiflex trunk interface card (VWIC-1MFT-T1, VWIC-1MFT-E1, VWIC-2MFT-T1, VWIC-2MFT-E1, VWIC-2MFT-T1-DI, or VWIC-2MFT-E1-DI) for a voice connection. You can install one multiflex trunk interface card (providing up to two voice ports) in the ATM OC-3/STM-1 circuit emulation service network module. If a multiflex trunk interface card is not installed, the ATM OC-3/STM-1 circuit emulation service network module continues to perform data-routing functions.

Note 1- or 2-port T1 or E1 multiflex trunk interface cards that support G.703 (VWIC-1MFT-G703, VWIC-2MFT-G703) are not supported in ATM OC-3/STM-1 circuit emulation service network modules.

Figure 7 ATM OC-3 Multimode Fiber Network Module

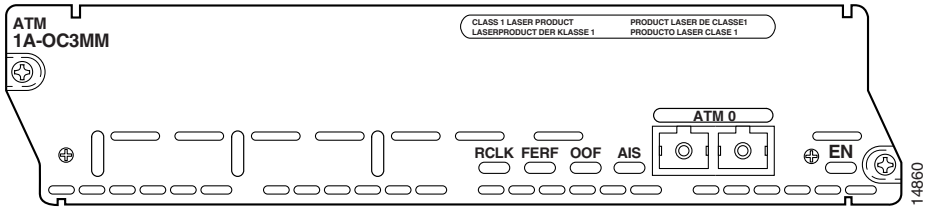


Figure 8 ATM OC-3 Single-Mode Intermediate-Reach Fiber Network Module

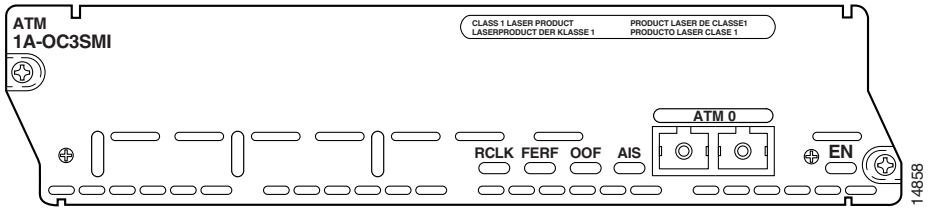


Figure 9 ATM OC-3 Single-Mode Long-Reach Fiber Network Module

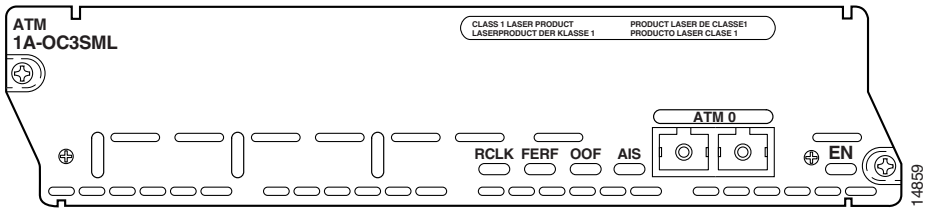


Figure 10 ATM OC-3/STM-1 Circuit Emulation Service Multimode Fiber Network Module

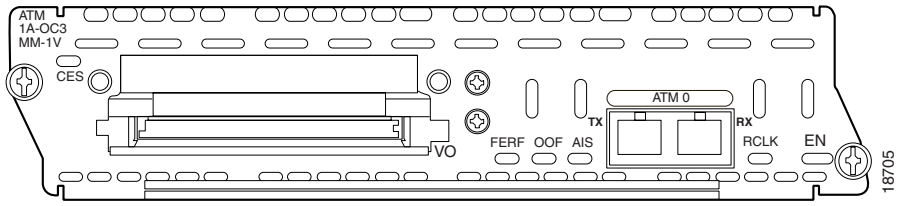


Figure 11 ATM OC-3/STM-1 Circuit Emulation Service Single-Mode Intermediate-Reach Fiber Network Module

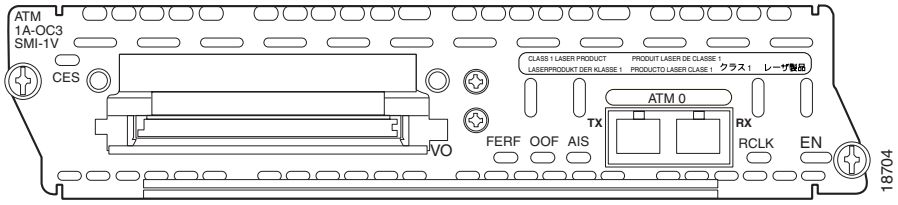
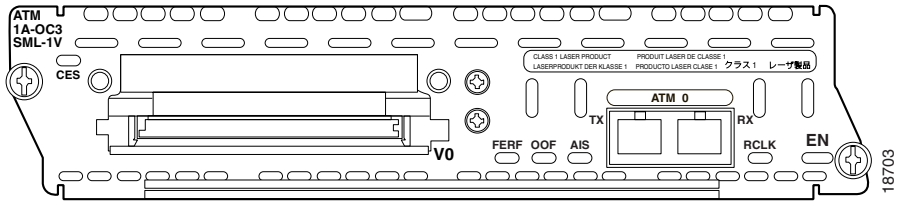


Figure 12 ATM OC-3/STM-1 Circuit Emulation Service Single-Mode Long-Reach Fiber Network Module



ATM OC-3 Network Module LEDs

Figure 13 and Figure 14 show ATM OC-3 network module LEDs.

Figure 13 ATM OC-3 Network Module LEDs

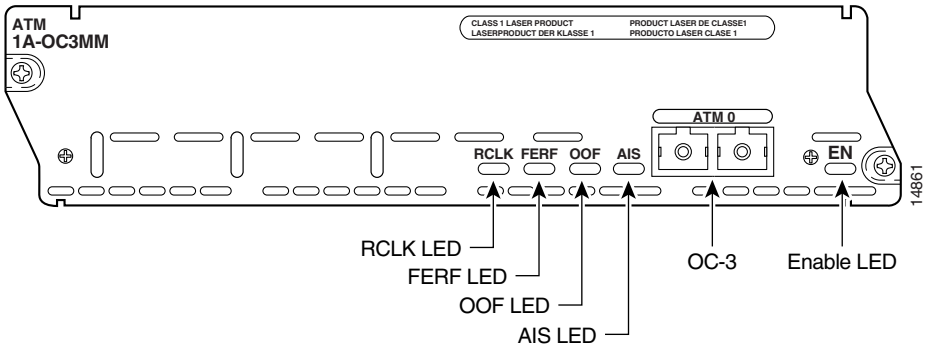
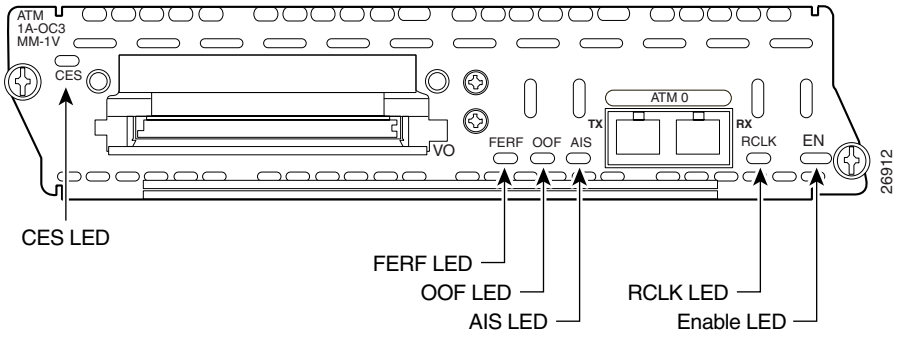


Figure 14 ATM OC-3/STM-1 Circuit Emulation Service Network Module LEDs



LED	Color	Meaning
EN	Green	Module has passed its self-tests and is available to the router.
RCLK	Green	Receive clock has been detected.
FERF	Yellow	Far-end receive failure.
OOF	Yellow	Out of frame.
AIS	Yellow	Alarm indication signal.
CES	Green	An active CES connection is established (ATM OC-3/STM-1 circuit emulation service network module only).

Hardware Compatibility with Cisco 3620 Routers

Cisco 3620 routers require a minimum PCMCIA controller revision level to recognize ATM OC-3 network modules; otherwise, an error message appears. Cisco 3620 routers installed in the field before April 1999 contain a Revision C PCMCIA controller, which is not compatible with these modules. Starting in April 1999, all Cisco 3620 routers shipped from the factory include Revision E PCMCIA controllers, which are fully compatible with all three ATM OC-3 network modules.

You can identify the version of PCMCIA controller in your Cisco 3620 router by entering the **show pci hardware** command in privileged EXEC mode, or by examining the part number on the motherboard. Supported versions are shown in Table 4.

Table 4 Cisco 3620 Router Versions for ATM OC-3 Network Modules

	Does Not Support ATM OC-3	Supports ATM OC-3
PCMCIA controller	0x22, 0xE2	0x20, 0xE0
Motherboard	73-1850-10 and older	73-1850-11 or newer

The output of the **show pci hardware** command looks similar to this:

```
Router# show pci hardware

CLPD6729 registers:
    (0x00) Chip Revision = 0x82
    (0x1E) Misc Control 2 = 0x08
    (0x1F) Chip Information = 0xE2
```

CES Cross-Connection on the Cisco 3660 Router

The Cisco 3660 router can deliver traditional PCM-encoded 64-kbps circuit-based voice over the ATM OC-3 CES network module. To use this functionality, the multiservice interchange card (MIX) must be installed on the Cisco 3660 router. T1/E voice channels on NM-xFE2W and NM-HDV network modules can be transported across the MIX module to ATM OC-3 network modules (NM-1A-OC3XX-1V) over an ATM network. PVC-based (permanent virtual circuit) CES allows service providers to quickly deliver local or long distance voice, while SVC (switched virtual circuit) capabilities ensure that these services are optimized for maximum profitability.

To install the MIX card, see the *Installing the Multiservice Interchange Card in Cisco 3660 Routers* document. To configure CES, see the *OC-3/STM-1 ATM Circuit Emulation Service Network Module* document.

Connecting ATM OC-3 Ports to the Network

To connect an ATM OC-3 network module to the network, insert a fiber-optic cable with one duplex SC connector (see Figure 15) or two simplex SC connectors (see Figure 16) into the ATM interface.

Note Some network modules are shipped with a dust plug to protect this interface. Pull to remove it.

Figure 15 Duplex SC Connector

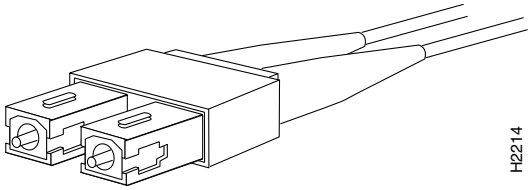
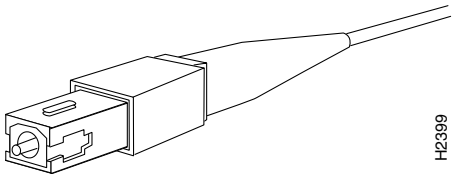


Figure 16 Simplex SC Connector



Note Cisco does not sell these fiber-optic cables, but they are available from many cable vendors. Cables should perform to the specifications listed in Table 5.

Table 5 Fiber-Optic Cable Specifications

Standard	Maximum Path Length	Cabling
ISO/IEC 9314-3	1.24 miles (2 km) all cables in a connection, end to end	62.5-micron core with an optical loss of 0 to 9 dB, or 50-micron core with an optical loss of 7 dB
IEC 793-2	27.9 miles (45 km) for SML and 9.3 miles (15 km) for SMI	9-micron core
ANSI/TIA/EIA-492 CAAA	27.9 miles (45 km) for SML and 9.3 miles (15 km) for SMI	9-micron core

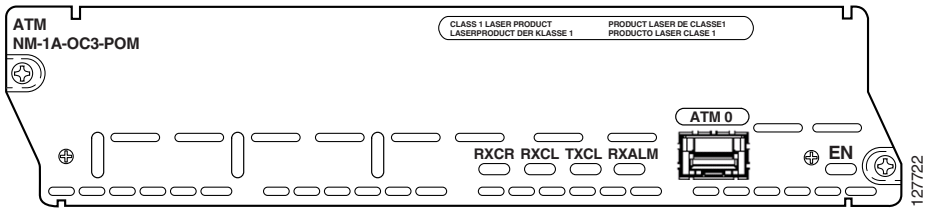
Note A single fiber link should not mix 62.5- and 50-micron cable.

ATM-OC3-POM Network Module for Cisco 3800 Series Routers

The NM-1A-OC3-POM network module provides a high-performance fiber uplink port for Cisco 3800 series integrated services routers. See Figure 17. Supported platforms are:

- Cisco 3825 integrated services router
- Cisco 3845 integrated services router

Figure 17 ATM OC3-POM Network Module



The ATM interface is the small form-factor pluggable (SFP) optical port labeled ATM 0. See Figure 17. The optical interface is provided by an SFP module that is inserted into the SFP port. Fiber-optic cables to the network are attached to the SFP module.

The network module has three modes of operation. The mode of operation is determined by the SFP module that is used.

Caution Only SFP modules provided by Cisco should be used in the network module. SFP modules that are not provided by Cisco have not been evaluated for reliability or user safety.

The modes of operation and usable SFP modules are:

- Multimode (MM)
  - POM-OC3-MM

  - SFP-OC3-MM
- Single-mode intermediate reach (SMI)
  - POM-OC3-SMIR
  - SFP-OC3-IR1
- Single-mode long reach (SML)
  - POM-OC3-SMLR
  - SFP-OC3-LR1

ATM-OC3-POM Network Module LEDs

Table 6 describes the functions of the LEDs on the ATM-OC3-POM network module shown in Figure 17.

Table 6 ATM-OC3-POM LED Functions

LED	Color	Meaning
RXCR	Green	Lit when carrier signal into the network module is present.
RXCL	Green	Blinks to indicate packet reception.
TXCL	Green	Blinks to indicate packet transmission.
RXALM	Yellow	Alarm indication signal.
EN	Green	Module has passed its self-tests and is available to the router.

Connecting ATM-OC3-POM Ports to the Network

The following sections describe how to remove and install SFP modules, and how to connect the ports on a module to the network.

Handling an SFP Module

Before handling an SFP module, observe the following guidelines:

- SFP modules are static-sensitive. To prevent electrostatic discharge (ESD) damage, follow your normal board- and component-handling procedures.
- SFP modules are dust-sensitive. When storing an SFP module or when a fiber-optics cable is not plugged into the connector, always keep plugs in SFP module optical bores.

Note The most common source of contaminants in the optical bores is debris picked up on the ferrules of the optical connectors. Use alcohol swabs or lint-free absorbent wipes to clean the ferrules of the optical connector.

Removing an SFP Module

The following procedure describes removing an SFP module from the network module.

Warning **Ultimate disposal of this product should be handled according to all national laws and regulations.** Statement 1040

Caution You can remove and install SFP modules with power on to the system; however, we strongly recommend that you do not remove or install an SFP module with optical fiber cables attached.

To remove an SFP module, perform the following steps:

Step 1 Attach an ESD wrist strap to your wrist and to the ESD connection socket on the chassis or to a bare metal surface on the chassis or frame.

Step 2 Disconnect the network fiber cable from the SFP module connector.

Step 3 Remove the SFP module from the slot.

a. Using your thumb and forefinger, grip the colored latching band on the front of the SFP module.

b. Gently push the latching band back toward the SFP port. You may hear a click or feel the SFP module disengage from the holding latch.

Note Not all SFP modules have the same kind of latching mechanism.

c. While still holding the latching band, pull the SFP module forward and out of the slot.

Step 4 Set the SFP module aside on an antistatic surface.

Installing an SFP Module

Use the following procedure to install an SFP module:

Step 1 Attach an ESD-preventive wrist strap to your wrist and between yourself and an unpainted chassis surface.

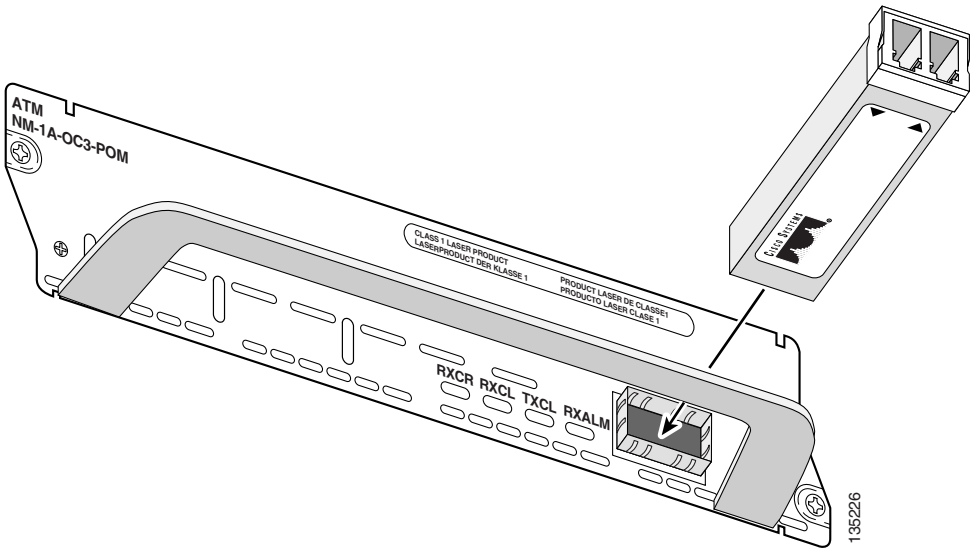
Step 2 Verify that you have the correct SFP module for your installation.

- Check the part number and distance information on the SFP module label.
- Alternatively, if the distance information is not on the label, use the **show contr pos x/y** command to display the information after the SFP module is installed.

Step 3 Align the SFP module with the slot so that the label is facing away from the handle.

Step 4 Holding the module at the latching band (with your thumb and forefinger), insert the SFP module into the slot on the SFP port. See Figure 18.

Figure 18 Installing an SFP Module



Step 5 Push the module back into the slot until the latch engages. When fully inserted, only the band around the front of the SFP module should be visible.

Step 6 Remove the plug from the SFP module optical bores and save the plug for future use.

Step 7 Attach the network interface fiber-optic cable, as described in the "Connecting ATM OC-3 Ports to the Network" section on page 9.

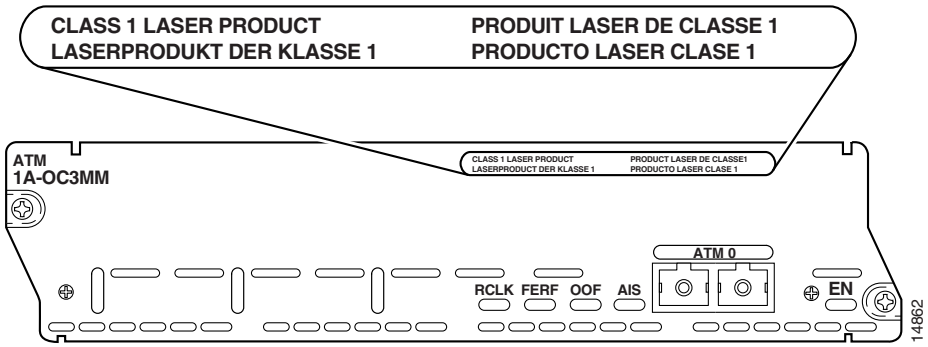
Laser Safety Guidelines

ATM OC-3 network modules use a small laser to generate the fiber-optic signal. Keep the transmit port covered whenever a cable is not connected to it.

Warning **Because invisible laser radiation may be emitted from the aperture of the port when no fiber cable is connected, avoid exposure to laser radiation and do not stare into open apertures.** Statement 240

The module faceplate carries a Class 1 laser warning label. See Figure 19.

Figure 19 Class 1 Laser Warning Label



Fiber-Optic Transmission Specifications

This section describes Synchronous Optical Network (SONET) specifications for fiber-optic transmissions, defines the power budget, and helps you estimate your power margin for multimode and single-mode transmissions. This section contains the following information:

- SONET Distance Limitations
- Power Budget and Power Margin
- Link Loss
- Estimating the Power Margin
- Single-Mode Transmission

SONET Distance Limitations

The SONET specification for fiber-optic transmission defines two types of fiber, single-mode and multimode. Single-mode fiber allows only one bundle of light rays to propagate through the fiber, whereas multimode fiber allows multiple bundles entering at different angles. Because different bundles (referred to as modes) travel different distances, depending on the entry angle, they arrive at the destination at different times (modal dispersion). Single-mode fiber is capable of higher bandwidth and greater cable run distances than multimode fiber.

Table 7 lists typical maximum distances for single-mode and multimode transmissions, as defined by SONET. Use the calculations described in this section to determine the actual maximum for your network. If the distance between two connected stations exceeds this limit, transmission can become unreliable.

Table 7 Typical SONET Maximum Fiber-Optic Transmission Distances

Transceiver Type	Maximum Distance Between Stations
MM	1.5 miles (2 km)
SMI	9 miles (15 km)
SML	28 miles (40 km)

Power Budget and Power Margin

Proper operation of an optical data link depends on modulated light reaching the receiver with enough power to be demodulated. The power budget (PB) is the difference between transmitter power (PT) and receiver sensitivity (PR). For instance, if transmitter power is –20 dB and receiver sensitivity is –30 dB, the power budget is 10 dB:

PB = PT – PR

PB = –20 dB – (–30 dB)

PB = 10 dB

The SONET specification requires that the signal meet the worst-case requirements listed in Table 8.

Table 8 SONET Signal Requirements

	MM	SMI	SML
Transmitter power	–20 dBm	–15 dBm	–5 dBm
Receiver sensitivity	–30 dBm	–31 dBm	–34 dBm
Power budget	10 dBm	16 dBm	29 dBm

The difference between the power budget and the link loss (LL) is called the power margin (PM). If the power margin is zero or positive, the link should work. If it is negative, the signal may not arrive with enough power to operate the receiver.

Link Loss

Power loss over a fiber-optic link arises from the following causes:

- Passive components—Attenuation caused by cables, cable splices, and connectors is common to both multimode and single-mode transmission. Attenuation is significantly lower for optical fiber than for other media.
- Chromatic dispersion—The signal spreads in time because of differing speeds of the different wavelengths of light.
- Modal dispersion—In multimode fiber, the signal spreads in time because of the different propagation modes.
- Higher-order mode loss (HOL)—This loss results from light radiated into the fiber cladding.
- Clock recovery at the receiver—This recovery consumes a small amount of power.

The power lost over the data link is the sum of all these losses. Table 9 gives an estimate of the amount of loss attributable to each cause.

Table 9 Link Loss Causes and Amounts

Cause	Amount of Loss
Fiber attenuation	SM: 0.5 dB/km MM: 1 dB/km
Splice	0.5 dB
Connector	0.5 dB
Modal and chromatic dispersion	Depends on fiber and wavelength[1]

Table 9 Link Loss Causes and Amounts

Cause	Amount of Loss
Higher-order mode losses	0.5 dB
Clock recovery	1 dB

1. Dispersion is usually negligible for single-mode fiber. For multimode fiber, the product of bandwidth and distance should be less than 500 MHz-km.

Estimating the Power Margin

The following example calculates a multimode power margin based on these values:

- Power budget 10 dB (SONET worst-case specification for multimode fiber)
- Link length 3 km
- Four connectors
- Three splices
- Higher-order loss (HOL)
- Clock recovery

The power margin is:

PM = PB – LL

= 10 dB – [3 km x (1.0 dB/km) + 4 x (0.5 dB) + 3 x (0.5 dB) + 0.5 dB + 1 dB] = 2 dB

The positive result means this link should have enough power for transmission. The product of bandwidth and distance is 155 MHz x 3 km = 465 MHz-km; this is within the dispersion limit of 500 MHz-km.

Single-Mode Transmission

Single-mode transmission is useful for longer distances, because there is a single transmission path within the fiber and modal dispersion does not occur.

The maximum receive power for SML is –10 dBm, and the maximum transmit power is 0 dBm. The SML receiver can be overloaded when using short lengths of fiber. Overloading the receiver does not damage it, but can cause unreliable operation. To prevent overloading an SML receiver, insert a minimum 10-dB attenuator on the link between any SML transmitter and the receiver.

The SMI receiver cannot be overloaded by the SMI transmitter and does not require a minimum fiber cable length or loss.

The following example of a single-mode power margin assumes these values:

- Power budget 16 dB (SONET worst-case specification for SMI)
- Two buildings 8 kilometers apart
- Connections through a patch panel in an intervening building with a total of 12 connectors

PM = PB – LL

= 16 dB – 8 km x (0.5 dB/km) – 12 x (0.5 dB)

= 6 dB

The positive value means this link should have enough power for transmission.

Related Documents

For additional information, see the following documents and resources.

Related Topic	Document Title
Regulatory compliance and safety information	*Cisco Network Modules and Interface Cards Regulatory Compliance and Safety Information* http://www.cisco.com/en/US/docs/routers/access/interfaces/rcsi/IOHrcsi.html
Cisco IOS software website and reference documentation	*Cisco IOS Software* http://www.cisco.com/web/psa/products/index.html?c=268438303

Obtaining Documentation, Obtaining Support, and Security Guidelines

For information on obtaining documentation, obtaining support, providing documentation feedback, security guidelines, and also recommended aliases and general Cisco documents, see the monthly *What's New in Cisco Product Documentation*, which also lists all new and revised Cisco technical documentation, at:

http://www.cisco.com/en/US/docs/general/whatsnew/whatsnew.html

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